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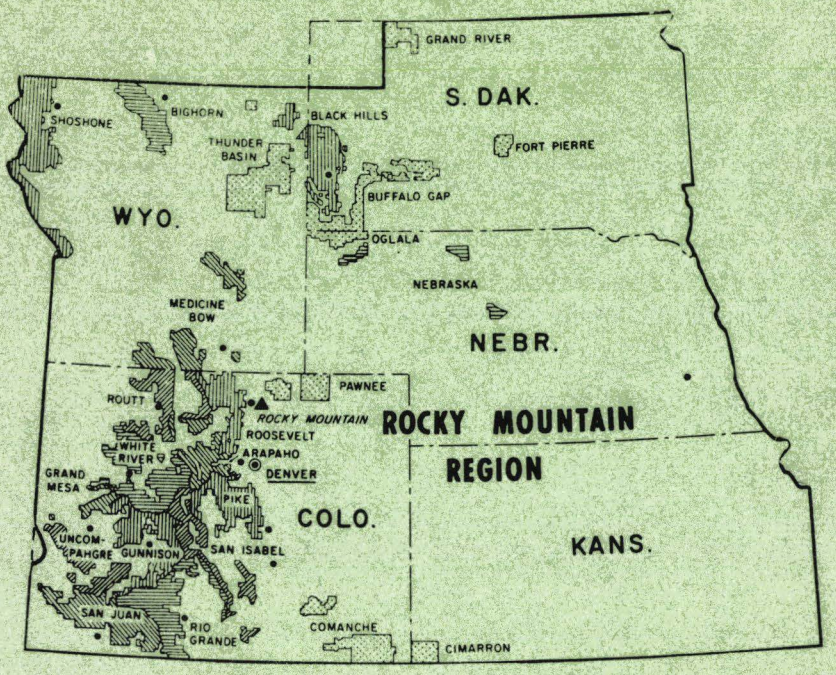
BIOLOGICAL EVALUATION

TIP MOTH
Ponderosa Pine Provenance Plantation
Hastings, Nebraska

September, 1974



U. S. DEPARTMENT OF AGRICULTURE - FOREST SERVICE
Division of State and Private Forestry
Region 2
Denver, Colorado

HERAS
JUN 12 1975
ROCKY MOUNTAIN STATION

BIOLOGICAL EVALUATION

TIP MOTH
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INTRODUCTION

On the 18th and 19th of September, Ralph Read, Research Forester, Rocky Mountain Forest and Range Experiment Station, Lincoln, Nebraska, and Bob Averill, Entomologist, Forest Pest Management, State and Private Forestry, Lakewood, Colorado conducted an evaluation of tip moth on a ponderosa pine (Pinus ponderosa, Laws) provenance study near Hastings, Nebraska. High populations of the tip moth in 1968 which threatened research objectives were sprayed the following year.

TECHNICAL INFORMATION

Causal Agent: Rhyacionia frustrana (Comst.) Nantucket pine tip moth is the primary species. In addition both R. bushnelli (Busck) western pine tip moth and R. neomexicana (Dyar) southwestern pine tip moth are probably present, based on finding old puparia in the soil/duff layer and at the root collar. The genus Rhyacionia is currently undergoing a revision and species determination is difficult at this time.

Host: The plantation examined is part of the Great Plains provenance study of P. ponderosa, Laws. Eighty seed sources from eight ecotypes are represented in the plantation in four tree and twenty-five tree plots. The plantation was established in 1968. Tree height ranges from two to ten feet.

METHODS

Data were collected by seed source as differential insect-host responses were anticipated in this provenance plantation. Three of the fifteen replicated sources were sampled for incidence of attack on the terminals. Attacks were separated by year from 1972 to 1974.

The rate of attack (infestation) was expressed as the product of: number of trees in seed source x 3 (years) ÷ number of terminal attacks. Dating of the attacks was by analysis of the nodal region. If lateral buds were hollow or branch-terminal deformity present at the node an attack was assumed to have taken place. No attempt was made at determining insect density on each terminal.

RESULTS

The mean infestation in terminals for all seed sources was: 54% - 1972; 79% - 1973 and 58% - 1974. Mean terminal infestation by geographic origin for all years are presented in Table 1. Table 2 shows the distribution of seed origins at each infestation rate. Seed source #720 from Ainsworth, Nebraska, indicates a significant lower infestation rate than the other sources. A t-test to compare the mean infestation rate of source #720 with the mean infestation rate of all the other seed sources was conducted. The results indicate that source #720 is significantly different in its infestation rate at the .001 level than the other seed sources.

DISCUSSION

The results have implications for both management and research. Beck (1965) defined host resistance as "the collective heritable characteristics by which a plant species, race, clone, or individual may reduce the probability of successful utilization of that plant as a host by an insect species, race, biotype or individual." This definition of host resistance is broad, but it does point out the complexity of the situation. Hanover (1974) has indicated four mechanisms of host behavior which can lead to tree resistance to insect attack.

These are:

1. Morphology and anatomy of the host.
2. Chemical repellents produced by the host.
3. Chemical attractants produced by the host.
4. Nutritional status of the host.

These categories, as Hanover points out, are more specific and more host-oriented than Painters' (1958) three categories of (a) preference or non-preference, (b) antibiosis, and (c) tolerance. The literature is rich in examples of "resistance" to insects by various hosts. However,

we know little about the chemical constituents and their physiology in relation to the insect resistance phenomenon. The interaction of host-insect-site is a reflection of the nutritional status of the host which needs further evaluation.

The three Rhyacionia species are quite close taxonomically and are separated by their overwintering sites. Because of this, pupal sampling requires searching three different sites which is a time consuming task and has several drawbacks in predicting trend. Whether there is differential species attraction to the various seed origins is unknown. The distribution of the three Rhyacionia species is unclear on the Plains.

Because of tip moths, planting of ponderosa pine on the Plains has been reduced in recent years. In some areas growth has been severely hampered and some spot mortality may have occurred. It may be that two factors have enhanced the tip moth problem. These are: 1. planting seed sources not native to the Plains region, and 2. planting ponderosa pine on sites not suited for ponderosa pine. The first factor would tend to concur with that possibility since only the lower eastern plains seed source show an indication toward reduced attacks, reflecting possible long term genetic drift toward survival of the more adapted specimens. The second factor needs verification through soil and foliar analysis among sites which show a range of susceptibility to the moths, as well as growth response.

RECOMMENDATIONS

1. That a more reliable sampling system for Rhyacionia be developed which could be utilized for trend prediction. Millers (1967) work on the European pine shoot moth provides a wealth of knowledge which may serve as a basis for the native species of this genus.

2. That an adequate impact analysis involving host-insect-site interactions as well as socio-economic values be undertaken.

3. That no tip moth control take place on the provenance plantations in order to further evaluate the impact of tip moth on the various seed sources.

Geographic Origin	Number of origins	Mean infestation rate (%)
Ore., Wash., Idaho, Bitteroots	7	56.7
Transition Zone	3	50.0
Central Montana	7	64.7
Central Rockies	12	56.5
So. Rockies, So. Plains	8	70.8
Black Hills, No. Plains	29	64.5
Low Elevation Ea. Plains	5	40.0
Central high Plains	8	68.8
ALL SOURCES	79	61.6

Table 1. Mean tip moth infestatation rates on ponderosa pine geographic seed origins

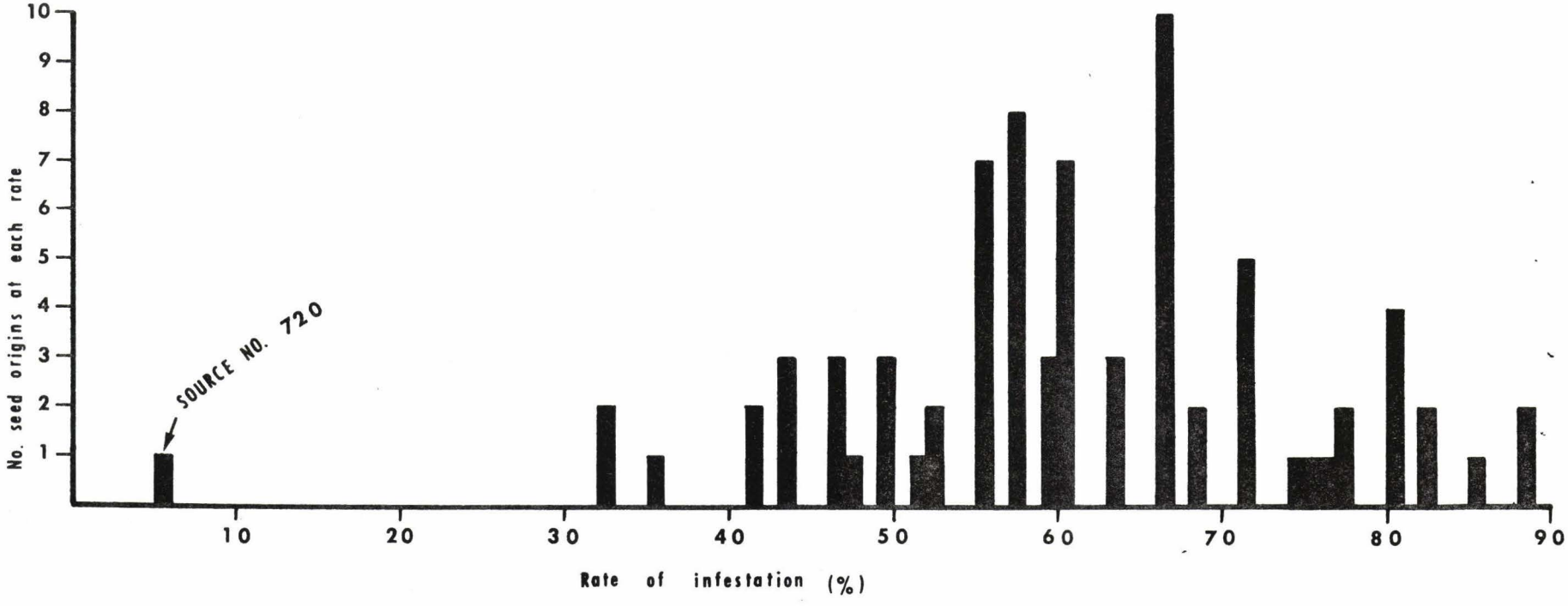

Table 2. Distribution of seed origins at each infestation rate.

4. That a coordinated approach to solving the tip moth problem through meetings with interested States, Rocky Mountain Forest and Range Experiment Station, Pest Control and interested parties would be beneficial.

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